Functional Electrical Stimulation in Spinal Cord Injury: Clinical Evidence versus Daily Practice

Bersch I, Frotzler A, Baumberger M
1Swiss Paraplegic Centre Nottwil, Switzerland

ines.bersch@paralpegie.ch

Abstract: Functional electrical stimulation (FES) has clinical evidence in the rehabilitation of patients with spinal cord injury. Nevertheless, looking into daily clinical practice, the use of FES is poor. Expenditure of time, complexity of technical equipment and compliance and acceptance of therapists and patients should be discussed as limiting factors.

Keywords: spinal cord injury, functional electrical stimulation, rehabilitation, daily practice

Introduction

Functional electrical stimulation (FES) is an inherent part of rehabilitation in spinal cord injury. It is amongst others used for preserving and increasing muscle mass [1,2,3], contracture prophylaxis [4], treating and preventing pressure ulcers [5,6,7,8] neuromodulation [9], motor-learning [10,11] improve and support coughing [12], improve and support function of upper and lower extremities [13,14] as well as reducing spasticity [15,16,17]. However, the findings of the above-mentioned effects were proved in research settings. Therefore, the aim of this study was to verify the evidence, acceptance and feasibility of FES in clinical and domestic setting.

Methods

Design: Retrospective observational study
Setting: Swiss Paraplegic Centre Nottwil (Switzerland) Patients: Woman and men aged at least 16 years, following an upper or lower motor neuron lesion due to a traumatic or non-traumatic spinal cord lesion with an American Spinal Injury Association (ASIA) Impairment Scale A/B/C/D.

Data extraction: Number of patients, focus as well as amount of stimulation in either a clinical or a domestic setting were extracted from patient charts of the years 2011 and 2012. Data of stimulation sessions focused on preserving and increasing muscle mass, contracture prophylaxis of upper and lower limbs, treating pressure ulcers, preventing pressure ulcers, neuromodulation, motor learning, support coughing, improve and support function of upper limbs, improve and support function of lower limbs and management of spasticity by using FES were included. The number of patients who continued stimulation after rehabilitation in domestic setting was separately evaluated. Assessments: 6 min. walking test, WISCI II, British medical council scale, (COPM) and power output measure of the MotionMaker. Individual different effects were observed in the Ashworth and Spasm frequency scale.

Table 1: Number of patients and amount of stimulation

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of IN Patients</td>
<td>113</td>
<td>153</td>
</tr>
<tr>
<td>Number of Stimulation sessions for IN Patients</td>
<td>2941</td>
<td>2071</td>
</tr>
<tr>
<td>Number of OUT Patients</td>
<td>29</td>
<td>32</td>
</tr>
</tbody>
</table>

Results

Data of a total of 266 inpatients and 61 outpatients were extracted (Tab. 1). In the clinical setting, EMG-triggered FES with visual or acoustic feedback for motor learning and the stimulation of single muscles or muscle groups to improve function was mostly used. The number of patients using FES for treating and preventing pressure sources increased in the last year. Only a few number of spinal cord injured patients used stimulation for preserving muscle mass, coughing and reducing spasticity (Tab.2). Clinical relevant improvements following FES interventions were found in 6 min. walking test, WISCI II, British medical council scale, (COPM) and power output measure of the MotionMaker. Individual different effects were observed in the Ashworth and Spasm frequency scale.

Table 2: Number of patients and focus of stimulation

<table>
<thead>
<tr>
<th>Focus of Stimulation</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>preserving muscle mass</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>contracture prophylaxis</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>treating pressure ulcers</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>neuromodulation</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>motor learning</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>support coughing</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>improve and support function of upper limbs</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>improve and support function of lower limbs</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>reducing spasticity</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Discussion

FES seems to be accepted by the patients as an inherent part of rehabilitation. Furthermore, FES interventions
seem to be implementable in daily clinical practice. In persons with spinal cord injury the main focus lies on motor learning. Regarding outpatients, FES-interventions are much less conducted. It is assumed that the time-consuming aspect might be one reason to discontinue FES-interventions at home. The expenditure of time for each training is about 30 min to one hour, including preparation. Indeed, stimulation should be done regularly in order to benefit from its effect [18]. A noticeable effect is not always seen after the first treatment and the impact is not long lasting. To reach long term effects treatment needs to be continued over weeks and months. Unfortunately Swiss insurances do not pay for the equipment although some patients would effort the expenditure of time. Coughing, in case of tetraplegia with surface electrodes seems to be an easy method to cough efficiently. It would be easily possible to integrate into daily physiotherapy treatment. Success of FES is limited by expenditure of time, complexity of technical equipment, acceptance of therapists and financing.

Acknowledgement

We would like to thank Anna Müller (PT) to collect and review the stimulation protocols.

Bibliography

[13] Takuya Watanabe, Yoshihiko Tagawa, Member, IEEE, Eiichiro Nagasue and Naoto Shiba, Surface Electrical Stimulation to Realize Task Oriented Hand Motion, Minneapolis, Minnesota, USA, September 2-6, 2009